

**IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF OKLAHOMA**

<p>STATE OF OKLAHOMA, <i>et al.</i>,</p> <p style="text-align: center;"><i>Plaintiffs,</i></p> <p>v.</p> <p>TYSON FOODS, INC., <i>et al.</i>,</p> <p style="text-align: center;"><i>Defendants.</i></p>	<p>)</p> <p>)</p> <p>)</p> <p>)</p> <p>)</p> <p>)</p> <p>)</p> <p>)</p> <p>)</p>	<p>Case No. 4:05-cv-00329-GKF-PJC</p>
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AFFIDAVIT OF DR. TIMOTHY J. SULLIVAN

I, Timothy J. Sullivan, having been duly sworn, under oath, state that the following facts are true and correct to the best of my knowledge, information, and belief:

1. This Affidavit is based upon my personal knowledge. I would and could competently testify to the matters stated in this Affidavit if called as a witness.

2. I have authored thirty-six book chapters and peer-reviewed scientific journal articles that focus largely on aspects of lake and/or stream water quality. Those publications are as follows:

- a. T.J. Sullivan et al., *Streamwater Acid-Base Chemistry and Critical Loads of Atmospheric Sulfur Deposition in Shenandoah National Park, Virginia*, 137 ENVIRON. MONIT. ASSESS. 85 (2008).
- b. J. Zhai, C. T. Driscoll, T. J. Sullivan, & B. J. Cosby, *Regional Application of the PnET-BGC Model to Assess Historical Acidification of Adirondack Lakes*, 44 WATER RESOUR. RES. 1 (2008).
- c. T.J. Sullivan et al., *Assessment of the Extent to Which Intensively-Studied Lakes are Representative of the Adirondack Region and Response to Future Changes in Acidic Deposition*, 185 WATER AIR SOIL POLLUTION 279 (2007).

- d. T.J. Sullivan et al., *Spatial Distribution of Acid-Sensitive and Acid-Impacted Streams in Relation to Watershed Features in the Southern Appalachian Mountains*, 182 WATER AIR SOIL POLLUTION 57 (2007).
- e. T.J. Sullivan et al., *Surface Water Acidification Responses and Critical Loads of Sulfur and Nitrogen Deposition in Loch Vale Watershed, Colorado*, 41 WATER RESOURCE. RES. W01021 (2005).
- f. T.J. Sullivan et al., *Assessment of Water Quality in Association With Land Use in the Tillamook Bay Watershed, Oregon*, 161 WATER AIR SOIL POLLUTION 3 (2005).
- g. T.J. Sullivan et al., *Application of a Regionalized Knowledge-Based Model for Classifying the Impacts of Nitrogen, Sulfur, and Organic Acids on Lakewater Chemistry*, 18 KNOWLEDGE BASED SYSTEMS 55 (2005).
- h. M.C. Saunders, T.J. Sullivan, B.L. Nash, K.A. Tonnessen, & B.J. Miller, *A Knowledge-Based Approach for Classifying Lake Water Chemistry*, 18 KNOWLEDGE BASED SYSTEMS 47 (2005).
- i. T.J. Sullivan et al., *Regional Model Projections of Future Effects of Sulfur and Nitrogen Deposition on Streams in the Southern Appalachian Mountains*, 40 WATER RESOUR. RES. W02101 (2004).
- j. T.J. Sullivan et al., *Riparian Plantings and Fencing Improve Water Quality in Tillamook River Watershed (Oregon)*, 22 ECOLOG. RESTOR. 138 (2004).
- k. T.J. Sullivan et al., *Relationship Between Landscape Characteristics, History, and Lakewater Acidification in the Adirondack Mountains, New York*, 112 WATER AIR SOIL POLLUT. 407 (1999).

- l. T.J. Sullivan & B.J. Cosby, *Modeling the Concentration of Aluminum in Surface Waters*, 105 WATER AIR SOIL POLLUT. 643 (1998).
- m. R. Sinha, M.J. Small, P.F. Ryan, T.J. Sullivan, & B.J. Cosby, *Reduced-Form Modeling of Surface Water and Soil Chemistry for the Tracking and Analysis Framework*, 105 WATER AIR SOIL POLLUT. 617 (1998).
- n. T.J. Sullivan, *Ecosystem Manipulation Experimentation as a Means of Testing a Biogeochemical Model*, 21 ENVIRON. MGMT. 15 (1997).
- o. T.J. Sullivan et al., *Increasing Role of Nitrogen in the Acidification of Surface Waters in the Adirondack Mountains, New York*, 95 WATER AIR SOIL POLLUT. 313 (1997).
- p. T.J. Sullivan et al., *Influence of Organic Acids on Model Projections of Lake Acidification*, 91 WATER AIR SOIL POLLUT. 271 (1996).
- q. T.J. Sullivan et al., *Re-Examination of the Role of Landscape Change in the Acidification of Lakes in the Adirondack Mountains, New York*, 183 SCI. TOTAL ENVIRON. 231 (1996).
- r. T.J. Sullivan & B.J. Cosby, *Testing, Improvement, and Confirmation of a Watershed Model of Acid-Base Chemistry*, 85 WATER AIR SOIL POLLUT. 2607 (1995).
- s. T.J. Sullivan, *Progress in Quantifying the Role of Aluminum in Acidification of Surface Waters*, 3 J. ECOL. CHEM. 157 (1997).
- t. C.T. Driscoll, M.D. Lehtinen, & T.J. Sullivan, *Modeling the Acid-Base Chemistry of Organic Solutes in Adirondack, New York, Lakes*, 20 WATER RESOUR. RES. 297 (1994).
- u. T.J. Sullivan, *Whole Ecosystem Nitrogen Effects Research in Europe*, 27 ENVIRON. SCI. TECHNOL. 1482 (1993).

- v. T.J. Sullivan et al., *Use of Historical Assessment for Evaluation of Process-Based Model Projections of Future Environmental Change: Lake Acidification in the Adirondack Mountains, New York, U.S.A.*, 77 ENVIRON. POLL. 253 (1992).
- w. R.S. Turner, P.F. Ryan, D.R. Marmorek, K.W. Thornton, T.J. Sullivan, J.P. Baker, S.W. Christensen, & M.J. Sale, *Sensitivity to Change for Low-ANC Eastern US Lakes and Streams and Brook Trout Populations Under Alternative Sulfate Deposition Scenarios*, 77 ENVIRON. POLL. 269 (1992).
- x. T.J. Sullivan, *Long-Term Temporal Trends in Surface Water Chemistry*, ACID DEPOSITION AND AQUATIC ECOSYSTEMS: REGIONAL CASE STUDIES, SPRINGER-VERLAG, NEW YORK 615 (1991).
- y. J.M. Eilers, T.J. Sullivan, & K.C. Hurley, *The Most Dilute Lake in the World?*, 199 HYDROBIOLOGIA 1 (1990).
- z. T.J. Sullivan et al., *Quantification of Changes in Lakewater Chemistry in Response to Acidic Deposition*, 345 NATURE 54 (1990).
- aa. T.J. Sullivan et al., *Variation in Adirondack, New York, Lakewater Chemistry as a Function of Surface Area*, 26 WATER RESOUR. BULL. 167 (1990).
- bb. H.M. Seip, D.O. Anderson, N. Christophersen, T.J. Sullivan, & R.D. Vogt, *Variations in Concentrations of Aqueous Aluminum and Other Chemical Species During Hydrological Episodes at Birkenes, Southernmost Norway*, 108 J. HYDROL. 387 (1989).
- cc. C.B. Johnson, T.J. Sullivan, & D.J. Blick, *Defining Regional Populations of Lakes for the Assessment of Surface Water Quality*, 25 WATER RESOUR. BULL 1 (1989).

- dd. H.M. Seip, N. Christophersen, & T.J. Sullivan, *Episodic Variations in Streamwater Aluminum Chemistry at Birkenes, Southernmost Norway*, ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY OF ALUMINUM 159 (1989).
- ee. T.J. Sullivan et al., *The Influence of Organic Acid Anions and Aqueous Aluminum on Measurements of Acid Neutralizing Capacity in Surface Waters*, 338 NATURE 408 (1989).
- ff. T.J. Sullivan et al., *Atmospheric Wet Sulfate Deposition and Lakewater Chemistry*, 331 NATURE 607 (1988).
- gg. T.J. Sullivan et al., *Evaluation of the Role of Sea Salt Inputs in the Long-Term Acidification of Coastal New England Lakes*, 22 ENVIRON. SCI. TECHNOL. 185 (1988).
- hh. I.P. Muniz, R. Andersen, & T.J. Sullivan, *Physiological Response of Brown Trout Spawners and Post-Spawners to Acidic Streamwater*, 36 WATER AIR SOIL POLLUT. 371 (1987).
- ii. R. Andersen, Ø. Haraldstad, I.P. Muniz, & T.J. Sullivan, *Effects of Shellsand on Water Quality and Mature Brown Trout*, 40 FAUNA 150 (1987)(in Norwegian).
- jj. T.J. Sullivan et al., *Aqueous Aluminum Chemistry Response to Episodic Increases in Discharge*, 323 NATURE 324 (1986).

3. I have conducted research regarding the extent to which fecal coliform bacteria might move from pasture to stream. I have published such research in peer-reviewed and “grey” literature, which includes publications issued by government, academia, business and industry, but not controlled by commercial publishing interests. Such publications are as follows:

- a. T.J. Sullivan et al., *Efficacy of Vegetated Buffers in Preventing Transport of Fecal Coliform Bacteria From Pasturelands*, 40 ENVIRON. MGMT. 958 (2007).

b. T.J. Sullivan et al., *Relationship Between Size of Vegetated Buffers and Transport of Fecal Coliform Bacteria From Pasturelands Treated With Dairy Cow Manure*, 89 ABSTRACT. J. DAIRY SCI. Abstract 298 (2006).

c. T.J. Sullivan et al., *Evaluation of the Effects of Edge-of-Field Grass and Shrub Filter Strips on Fecal Coliform Bacteria Transport in an Agricultural Setting*, Final report prepared for Tillamook Estuaries Partnership, Garibaldi, OR by E&S Environmental Chemistry, Inc., Corvallis, OR (2006).

4. The principles underlying my research regarding the extent to which fecal coliform bacteria might move from pasture to stream can be extended to the movement of phosphorus, or other constituents, in the IRW.

5. It is common practice that spatial analyses of water quality data are based upon samples collected over widely varying periods of time, ranging from a few days or weeks to multiple decades.

6. The following studies focus on spatial analyses of water samples collected over various time periods.

a. In 2006, the U.S. EPA, published its Wadeable Streams Assessment which sampled 1,392 streams nationwide. The purpose of the study was to provide a statistically defensible summary of the condition of the nation's streams and small rivers. One annual sample was collected at each site during the summer season from 2000 to 2004.

b. In 2004, Jones, et al. published a study of nutrients in 135 Missouri reservoirs. The study identified the influence of watershed characteristics on reservoir limnology. The reservoirs were sampled seasonally on three or four occasions between May and

August. Individual reservoirs were represented in the data set by collections ranging from 4 to 21 summer seasons during the period 1978 to 2002. Most reservoirs were represented by data from 10 or more seasons.

- c. In 2007, Sullivan, et al. published a spatial distribution of stream acid-base chemistry in relation to watershed characteristics which looked at 909 streams in the southern Appalachian Mountains (an eight state region). The purpose of the study was to test hypotheses suggesting that stream acid-base chemistry is controlled by geologic, edaphic (soils), and topographic variables, using spatial data, at the regional scale. Each stream was represented by a single value collected in the 1990's or late 1980's during the spring season or the time most nearly representing the spring season.
- d. In 1997, Sullivan, et al. published a study on the role of nitrogen in surface water acidification in New York. The study examined the importance of nitrogen as an acidification agent in 1,469 lakes in the Adirondack Mountain region. Each lake was sampled by the Adirondack Lakes Survey Corporation once during the summer season in the years 1984 through 1990.
- e. In 2006, Alexander and Smith published a study on nutrients in U.S. rivers monitored by the USGS. The study examined trends in total P, total N, and trophic conditions in 250 nationally representative rivers throughout the U.S. Data were selected from monitoring sites spanning the period between 1973 and 1994, with each site having at least 70 measurements of total N and total P, with bimonthly sampling at most sites.
- f. In 2004, Graham, et al. published a study on environmental factors affecting microcystin distribution and concentration in the Midwestern U.S. The study documented microcystin occurrence and developed empirical relationships between the physicochemical environment and microcystin concentration in 241 lakes in

Missouri, Iowa, Kansas, and Minnesota. A total of 800 lake visits were performed from May 2000 to September 2001, with most lakes sampled two to four times during one or both years.

- g. In 2002, Sullivan, et al. produced the Tillamook State of the Bay Report. The Report assessed results of storm monitoring for fecal coliform bacteria, total suspended solids, and nutrients in four rivers in the Tillamook Bay watershed in Oregon. The Report relied on multiple sampling from 29 storms between 1996 and 2002.

FURTHER Affiant Sayeth Not.



Timothy J. Sullivan

State of Oregon)
) ss
County of Benton)

SUBSCRIBED AND SWORN to before me, a notary public, on this 4 day of
June, 2009.



Notary Public

My Commission Expires:

10/8/10

